limited to: businesses, companies, firms, public/private organizations, government agencies/institutions, etc.

[0020] In some implementations, beacon management service **112** communicates with enterprises **126***a*-**126***c* through network **110** (e.g., the Internet). Beacon management service **112** can be implemented using one or more server computers. At least one server computer can deliver web pages for a beacon management portal that can be accessed by authorized enterprise personnel or administrators using a browser running on an administrator computer, as described in reference to FIG. **6**. Beacon management service **112** can access beacon database **124**, which is configured to store beacon information as described in reference to FIGS. **2**A and **2**B.

[0021] Client device **106** operating in beacon environment **102** communicates wirelessly with beacon management service **112** through access point (AP) **108** (e.g., WiFi access point) and network **110**. Client device **106** includes a wireless transceiver that can detect radio frequency (RF) signals broadcast from beacons **104***a*-**104***c* when client device **106** is within communication range of beacons **104***a*-**104***c*. In the example shown, beacon environment **102** is an indoor environment (e.g., a retail chain store).

[0022] Client device **114** operating in beacon environment **114** communicates wirelessly with beacon management service **112** through cell tower **120**, gateway **122** and network **110**. Client device **116** includes a wireless transceiver that can detect RF signals broadcast from beacons **118***a*-**118***c* when client device **116** is within communication range of beacons **118***a*-**118***c*. In the example shown, beacon environment **114** is an outdoor environment (e.g., a musical festival).

[0023] Beacons **104**, **118** can be BLE beacons that comply with Bluetooth Core Specification 4.0 (hereafter referred to as the "BT Specification"). Any desired number of beacons can be deployed in beacon environments **102**, **114**. For example, beacons can be deployed in a retail store at an entrance, section (e.g., electronics section) and display (e.g., cell phone display).

[0024] Beacons **104**, **118** broadcast advertising packets referred to as PDUs that include headers that can be detected by client devices **106**, **116** when configured to run in scan mode. When a beacon wants to broadcast, it starts an advertising event, where the same advertising packet is transmitted sequentially on each of three advertising channels as defined in the BT Specification. There are four different types of advertising packets defined by the BT Specification: non-connectable advertising, discoverable advertising, general advertising and directed advertising. For beacons broadcasting non-connectable advertising packets, the beacon transmits a string of data but does not respond to a request from a client device to make a secure connection. The string can include information (e.g., a Uniform Resource Locator (URL)) directing a browser running on the client device to a secondary online source of information, such as website accessible by cellular or WiFi communication links

[0025] An example BLE protocol for proximity sensing is iBeacon® protocol developed by Apple Inc. (Cupertino Calif.). iBeacon® protocol specifies data elements or identifiers that can be programmed by users, as described in reference to FIGS. **2**A-**2**B. iBeacon® allows client devices **106**, **116** to scan and detect advertising packets from an iBeacon® as a background process. Once an application is installed on the client device, it can remain dormant until an appropriate iBeacon® is discovered. Advertising packets can be filtered and directed to specific applications installed on the client device or used to initiate actions on the client device with or without user intervention.

[0026] Beacon database **124** provides a centralized data store for enterprises to store their proprietary beacon information. Beacon database **124** can be a single database or a distributed database. Beacon database **124** can be a relational database that includes database tables. Beacon database **124** can include a database management system (DBMS) and schema that allows multiple enterprises to store and access beacon information for beacons used in their respective beacon environments.

[0027] In some implementations, each enterprise can be assigned one or more database tables that can be accessed through a beacon manager portal provided by beacon management service **112**. As previously described, the enterprise can read and write beacon information to its database tables using the portal or a data feed. Beacon information can include any information related to the commissioning and operation of beacons, including but not limited to: proximity ID, major, minor, transmitted signal strength, PUD type, PDU payload data, device filter (e.g., white list), advertising event timing or any other information or content.

[0028] FIG. **2**A is an example database table for a fictitious Acme Corporation. Each row of the database represents a beacon and each column represents beacon information. The database table can include more or few columns or rows based on the application.

[0029] In the example shown, Acme Corporation is a retail chain operator with two stores located in Redwood City and Mountain View Calif. Proximity IDs in column one can be assigned to various subsidiaries of Acme Corporation. For this example, a single UUID is assigned to Acme Corporation. The major values in column two identify each Acme store that has a beacon environment. For example, the Redwood City store is identified by the major value 1 and the Mountain View store is identified by the major value 2. In the Redwood City store, Acme has deployed BLE beacons at the entrance, at the electronics section and at a cell phone display in the electronics section. These three beacons are identified by minor values in column three as 1, 2 and 3.

[0030] In the Mountain View store, Acme has deployed BLE beacons at the entrance, at the grocery section and at a produce display in the grocery section. These three individual beacons are identified by minor values in column three as 1, 2 and 3.

[0031] Column four allows Acme to program the transmission (TX) power of individual beacons. An example TX power range can be −23 dBm to +10 dBm. In this example, Acme programmed the beacon at the entrance to have a high transmission power (e.g., +10 dBm) to ensure broadcasts from the beacon can be detected in scans by customer client devices outside the store entrance. The beacon deployed at the entrance transmits a PDU payload that includes a URL to the Acme home page, where featured weekly ads for the Redwood City store can be accessed by the customer via a browser.

[0032] The beacon at the electronics section is programmed by Acme to have a transmission power (e.g., 5 dBm) that is lower than the entrance beacon and higher than the beacon at the cell phone display to ensure broadcasts from the beacon can be detected in scans by customer client devices near the